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Attorney Docket No. 3600.100 Cont.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reissue Application of	)	Examiner: C. Verdier
DAVID A. SPEAR ET AL.	)	Group Art Unit: 3745
Appln. No.: 09/874,931	)	
Filed: June 5, 2001	)	
For: SWEPT TURBOMACHINERY BLADE	)	Application to reissue U.S. Patent 5,642,985

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL DECLARATION
OF FRANS A.E. BREUGELMANS

Sir:

I, Frans A.E. Breugelmans, do hereby declare as follows:

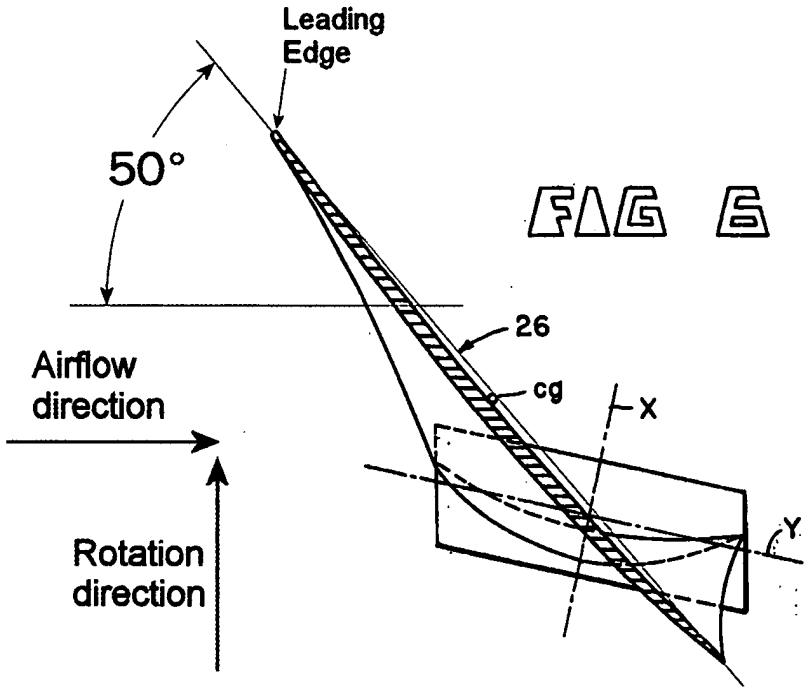
1. I am the same Frans A.E. Breugelmans who executed the Declaration of Frans A.E. Bruegelmans dated May 16, 2003 ("Original Declaration"), in the above-identified application. This Supplemental Declaration is submitted to further clarify my Original Declaration as it relates to claims 4 and 6 of U.S. Patent No. 6,071,077 to Paul A. Rowlands ("the Rolls '077 Patent"; Exhibit 5 to my Original Declaration).

Claim 4 of the Rolls '077 Patent

2. Claim 4 reads as follows:

> A fan stage of a ducted fan gas turbine engine as claimed in claim 3 wherein the blade is further characterised in that the stagger angle of the mid-height region of the blade is in the range from approximately 30° to approximately 55° relative to the airflow direction.

3. In my Original Declaration I stated, "I note also that Fig. 6 of Schwaar [U.S. Patent 4,012,172 to Schwaar et al.; Exhibit 6 to my Original Declaration] shows a swept fan blade with a stagger angle that measures between 30° and 55° in the blade mid-height region, although I cannot be certain that drawing is to scale." The following depiction, adapted from Fig. 6 of Schwaar, illustrates the basis of that statement.



4. The depicted airflow direction is in accordance with the blade orientation in Fig. 4's side elevation of the blade, Fig. 6 being a section taken from Fig. 4 at the blade's mid-height region. Schwaar, col. 3, lines 14-17. The fan rotation direction is labeled in accordance with conventional understanding, in that a fan rotates in a direction that causes each blade's leading edge (which I have labeled consistent with Fig. 4) to encounter the airflow. These airflow and rotation directions are also consistent with Fig. 2 of Schwaar. See col. 4, lines 3-6. The 50° angle shown in green is Schwaar's "setting angle" (labeled "t" in Fig. 2), which corresponds to the stagger angle in the Rolls '077 Patent, as seen in Fig. 6 thereof.

Claim 6 of the '077 Patent

5. Claim 6 reads as follows:

> A fan stage of a ducted fan gas turbine engine as claimed in claim 1 wherein the shape of the pressure surface of a swept fan blade and the suction surface thereof creates, in use, a line of minimum static pressure points on the suction surface of the blade, said line of minimum static pressure points is inclined with respect to the axial direction at a sweep angle which varies with span height of the blade, and has a negative value in a region of subsonic flow over the leading edge.

6. In my Original Declaration, I stated that an ordinarily skilled fan engineer following U.S. Patent 4,726,737 to Weingold et al. (Exhibit 7 to my Original Declaration) would have inclined the lines of minimum static pressure points at a sweep angle that varied with blade height, and that such sweep angle "would have been negative in the inner, subsonic-flow region of the blade . . . ." The basis for that statement can be understood by first considering that Weingold discloses a blade with a leading edge that is swept forward (that is, has a negative sweep angle) in an inner region adjacent the blade hub. This region of the leading edge is labeled in green in the following adaptation from Fig. 1 of Weingold.

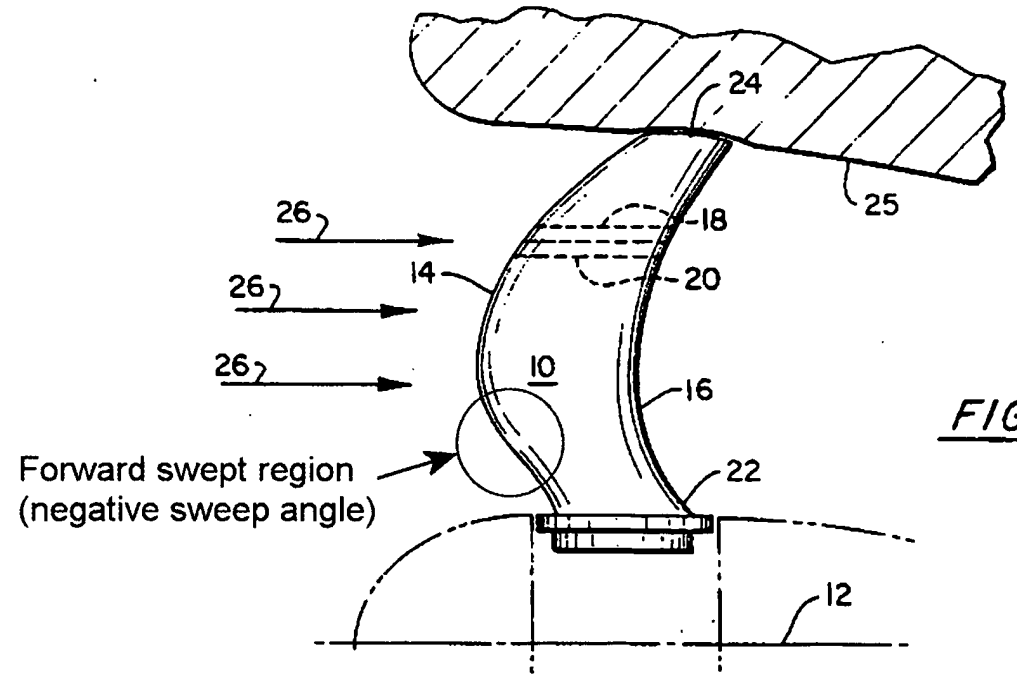


FIG. 1

7. The flow at the blade leading edge in this inner region is commonly subsonic because the blade's tangential velocity (in the direction of rotation) is relatively low near the hub. This is confirmed by Fig. 2 of U.S. Patent 3,989,406 to Bliss (Exhibit 8 to my Original Declaration), which shows a region of subsonic flow (M < 1) in a blade inner region.

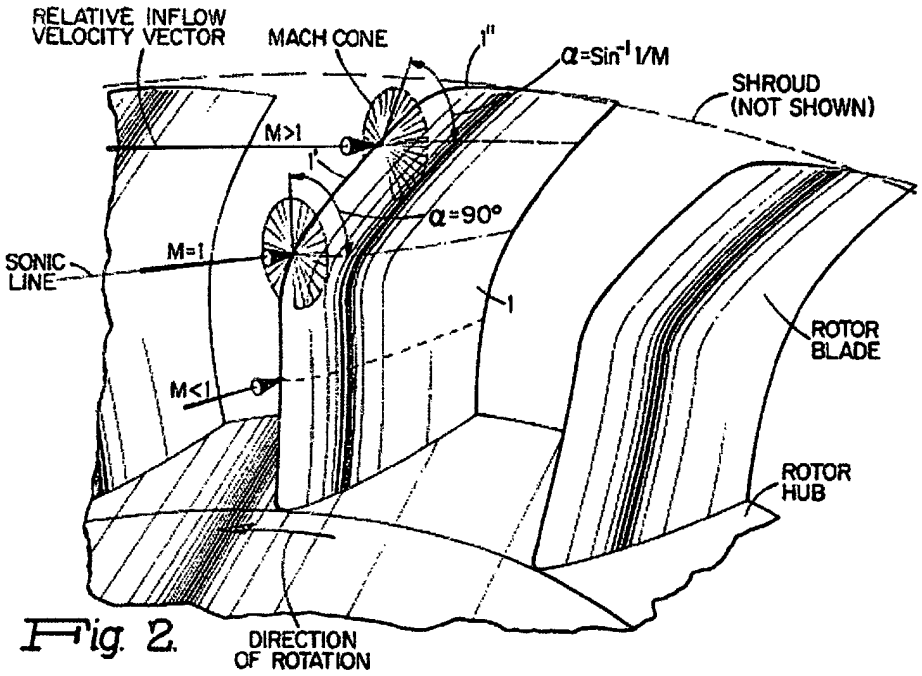


Fig. 2.

9. Fig. 2a of Weingold, reproduced below, shows a blade's maximum camber line 42 that is swept to generally follow the sweep of the leading edge. The maximum camber point of any subsonic airfoil section is associated with its minimum static pressure point, as explained in Weingold at column 5, lines 13-22 (see also Fig. 3). Accordingly, Weingold's line 42 corresponds to the line of minimum static pressure points along the blade's suction surface.

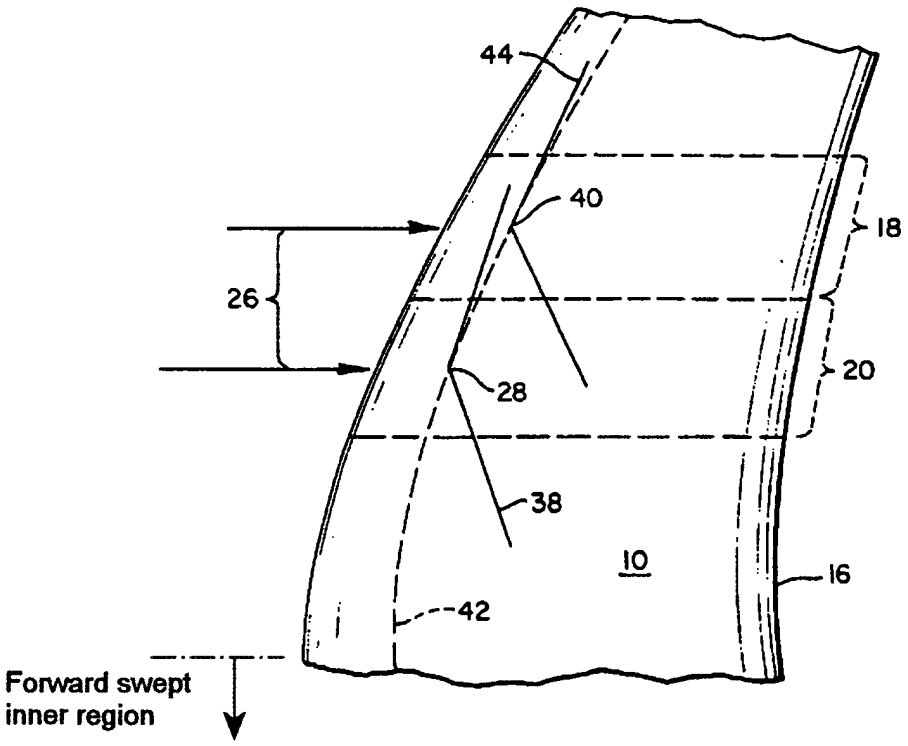


FIG. 2a

10. Fig 2a. shows the line 42 following the leading edge in a rearward swept outer region of the blade as it transitions to the forward swept inner region (labeled in green in Fig. 1 reproduced in paragraph 6 above). As an expert in axial-flow turbomachinery, it is my opinion that a fan engineer of ordinary skill would have used a blade configuration in which the line 42 continued generally to follow the blade leading edge from where it transitions to forward sweep (labeled in green above) at least part way down the inner region, if not all the way to the blade hub. To do otherwise would have required an abrupt change in the blade cross-sectional shape just below the blade height region illustrated in Fig. 2a, and a fan engineer would not normally have used such a blade configuration.

11. In other words, it was conventional to sweep the blade leading edge inner region forward (that is, for it to have a negative sweep angle), for the flow at the leading edge in that region to be subsonic, and for a fan engineer of ordinary skill to use a blade in which the

minimum static pressure line generally followed the leading edge within that region. Accordingly, it is my expert opinion that it would have been obvious to provide a blade having the features recited in claim 6 of the Rolls '077 Patent, including a line of minimum static pressure points that "has a negative value in a region of subsonic flow over the leading edge."

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that the statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title XVIII of United States Code, and that such willful false statements made jeopardize the validity of this application or any patent issued thereon.

Date: 27th Oct 2003

F. Breugelmans

Frans A.E. Breugelmans